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BULLETIN 9

Coal Mining Practice

IN

District III

BY

S. O. ANDROS

Urbana
University of Illinois
1915

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The Forty-seventh General Assembly of the State of Illinois, with a view of conserving the lives of the mine workers and the mineral resources of the State, authorized an investigation of the coal resources and mining practices of Illinois by the Department of Mining Engineering of the University of Illinois and the State Geological Survey in co-operation with the United States Bureau of Mines. A co-operative agreement was approved by the Secretary of the Interior and by representatives of the State of Illinois.

The direction of this investigation is vested in the Director of the United States Bureau of Mines, the Director of the State Geological Survey, and the Head of the Department of Mining Engineering, University of Illinois, who jointly determine the methods to be employed in the conduct of the work and exercise general editorial supervision over the publication of the results, but each party to the agreement directs the work of its agents in carrying on the investigation thus mutually agreed on.

The reports of the investigation are issued in the form of bulletins, either by the State Geological Survey, the Department of Mining Engineering, University of Illinois, or the United States Bureau of Mines. For copies of the bulletins issued by the State and for information about the work, address Coal Mining Investigations, University of Illinois, Urbana, Ill. For bulletins issued by the United States Bureau of Mines, address Director, United States Bureau of Mines, Washington, D. C.

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FIG. 1. Map showing area (shaded) of District III

COAL MINING PRACTICE IN DISTRICT III

By S. O. ANDROS

INTRODUCTION

District III of the Illinois Coal Mining Investigations, as shown in fig. 1, comprises those mines in Brown, Calhoun, Cass, Fulton, Greene, Hancock, Henry, Jersey, Knox, McDonough, Mercer, Morgan, Rock Island, Schuyler, Scott, and Warren Counties which work in Rock Island coal (bed 1) and Colchester coal (bed 2) of the Illinois Geological Survey correlation. A detailed description of the districts into which the State has been divided and the method of collecting the information upon which this bulletin is based is contained in Bulletin 1, "A Preliminary Report on Organization and Method."

The total recorded annual production of this district for the year ended June 30, 1912, 512,178 tons, is less than that of one large mine in some other districts, and the district is given a separate report only because it is necessary to do so in order to have a complete description of practice in the State. The recorded figures do not represent quite all the production because in several counties, such as Cass, Brown, Calhoun, Greene, Jersey, and Morgan, there is a little coal mined at outcrops and on various farms for home use. The amount thus mined is negligible by comparison with the reported production. Bed 1 is also mined at Assumption in Christian County, 100 miles east of District III, through a shaft 1004 feet deep, the deepest in Illinois. Although 75,000 tons are annually produced by the isolated Assumption mine, it is not included in District III on account of its geographical separation.

One local and four shipping mines were examined in this district in which there are 123 local and 5 shipping mines.

Comparative statistics have been compiled for the year ended June 30, 1912, although later information is available, because comparative statistics for districts previously reported on have been compiled for that year and there is thus made available a means for comparing all districts in the State.

TABLE 1.—*General data by counties for District III for the year ended June 30, 1912*[a]

County	No. mines		Production in short tons	Tons mined by machines	Average days of active operation	Total no. of employees	No. surface employees	No. kegs powder used in blasting coal	Haulage: No. mines using				Accidents to employees	
	Shipping	Local							Locomotives	Cable	Mules	Hand	No. killed	No. injured
Cass	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Calhoun	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fulton	1	30	50,690	0	144	167	25	3,094	1	0	1	29	1	1
Greene	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hancock	0	1	2,920	0	82	17	2	130	0	0	0	1	0	0
Henry	0	7	2,958	0	75	19	2	120	0	0	3	4	0	0
Jersey	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Knox	0	2	10,646	0	200	27	5	800	0	0	0	2	1	0
McDonough	0	41	23,612	0	134	147	0	50	0	0	0	41	1	0
Mercer	3	9	334,662	0	141	521	67	17,954	1	2	1	8	1	4
Morgan	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rock Island	1	11	71,696	9,500	162	152	33	2,757	0	0	2	10	0	1
Schuyler	0	4	2,736	0	129	10	2	156	0	0	0	4	0	0
Scott	0	6	3,760	0	171	15	2	0	0	0	0	6	0	0
Warren	0	12	8,498	0	107	44	4	550	0	0	0	12	0	0
Total	5	123	512,178	9,500	135[b]	1,119	142	25,381	2	2	7	117	4	6

[a]Compiled from Thirty-first Annual Coal Report of Illinois.
[b]Averaged by mines; not by counties.

Table 1 gives general data by counties. Table 2 gives comparative data for District III and the State for the year ended June 30, 1912.

The total production of District III is 0.9 per cent of the output of the State. The amount of powder used is out of proportion to the tonnage produced, 1.9 per cent of the powder used in Illinois being used in this district although a considerable quantity of the coal is brought down by wedge and sledge

TABLE 2.—*Comparative statistics for District III and the State for the year ended June 30, 1912*[a]

	District (All mines)	State (All mines)	Per cent of District
Total production	512,178	57,514,240	0.9
Average daily tonnage	3,794	359,464	....
No. tons mined by machine	9,500	25,550,019	....
Kegs of powder used in blasting coal	25,381	1,313,448	1.9
Days of active operation	135	160	....
Number of days work performed in 1912	151,065	12,705,760	....
Total employees	1,119	79,411	1.4
No. surface employees	142	7,049	2.0
No. underground employees	977	72,362	1.3
No. face workers (miners, loaders, and machine men)[b]	406	53,318	0.8
No. underground employees per each surface employee	6.9	10.3	....
No. tons mined per day per employee	3.4	4.5	....
No. tons mined per day per surface employee	26.7	50.9	....
No. tons mined per day per underground employee	3.9	4.9	....
No. tons mined per day per face worker[b]	7.6	6.7	....
No. fatal accidents	4	180	2.2
Per cent from falling rock or coal	50.0	54.4	....
Per cent from pit cars	25.0	18.8	....
Per cent from explosives	0.0	7.2	....
Per cent from gas explosions	0.0	6.9	....
No. deaths per 1000 employees	3.6	2.3	....
No. tons mined to each life lost	128,045	319,524	....
No. non-fatal accidents	6	800	0.7
Per cent from falling rock or coal	83.3	45.5	....
Per cent from pit cars	0.0	26.3	....
Per cent from use of explosives	0.0	2.6	....
Per cent from gas explosions	0.0	2.8	....
No. injuries per 1000 employees	5.4	10.1	....
No. tons mined to each man injured	85,363	71,893	....

[a]Compiled from Thirty-first Annual Coal Report of Illinois.
[b]Shipping mines only.

without powder. Only 1.9 per cent of the output is undercut by machines.

The two mines of the Coal Valley Mining Company are worthy of special mention inasmuch as they recover so large a percentage of the coal in the bed.

Acknowledgments should be made to the superintendents and mine managers who gave much help during the examination of the mines. Especially valuable aid was rendered by Mr. Carl Scholz, President, and Mr. Robt. E. Lee, General Superintendent, of the Coal Valley Mining Company, and by Mr. Wm. D. Godfrey, President of the Spoon River Coal Company, in supplying information and in reviewing the manuscript of this report.

DESCRIPTION OF COAL BEDS

The cover overlying beds 1 and 2 in District III is thin. Bed 1 in the mines examined lies at depths varying from 40 to 213 feet. The topography of the surface in many places is rolling, with hills about 150 feet high near Matherville. Bed 2 lies at depths of 7 to 100 feet with an average cover of 55 feet.

Bed 1 averages 4 feet in thickness and is broken in places by small faults, slips, clay veins, and rolls. The coal has weak vertical cleavage, dull luster and banded texture. On cleavage faces thick plates of calcite and iron pyrites are deposited. Near Ellisville sulphur bands 2 to 6 inches thick and in places 50 feet long are found at various horizons. A poorly developed parting divides the bed into two benches, the upper of which is in most places about 2 feet thick.

The immediate roof in the northwestern part of the district is a hard black shale that is easy to support. In the southern part of the district in places a bituminous calcareous shale, 2 to 5 inches thick, lies immediately over the coal. This shale, called clod, is hard when first exposed but after exposure to the air becomes soft and falls. Throughout the district the cap rock is limestone. In limited areas where the shale is missing this limestone is the immediate roof over the coal. Above the

TABLE 3.—*Analyses of coals in District III*[a]

No. bed	No. samples	Proximate analysis of coal: 1st, "as rec'd," with total moisture. 2nd, "Dry," or moisture free.				Sulphur	B. t. u.	Unit coal B. t. u.
		Moisture	Volatile Matter	Fixed Carbon	Ash			
1	11	15.58	39.17	35.80	9.45	4.69	10,673	....
		Dry	46.40	42.41	11.19	5.55	12,643	14,546
2	3	17.40	33.30	41.48	7.82	2.03	10,811	....
		Dry	40.32	50.23	9.48	2.45	13,091	14,663

[a]Analyses made by J. M. Lindgren under the direction of Prof. S. W. Parr.

cap rock is a dense, fine-grained non-crystalline limestone locally called "blue rock."

Below bed 1 in places there is an irregular band of hard bone, 3 to 6 inches thick. The floor proper is a light gray micaceous fireclay which contains plant stems and roots. This clay heaves badly when wet and in places swells enough to fill the entry. In parts of some mines a carbonaceous shale lies between the fireclay floor and the coal and in other parts, sandstone. These casual deposits are called "false bottoms."

Bed 2 varies in thickness from 1 foot, 10 inches to 4 feet and averages 2½ feet. The bed has a slight east dip for the district. The coal has a weak cleavage and dull luster. It is finely laminated and has numerous bands of mother coal and dirt, none of which is continuous. A band of mother coal and iron pyrites persists throughout the bed at a distance of 14 inches from the roof.

The immediate roof is a calcareous shale known locally as soapstone. It is regular and smooth and contains fossil leaves in places.

The floor is a soft gray fireclay which contains nodular concretions of iron pyrites called sulphur balls.

Table 3 gives analyses of the coals in beds 1 and 2.

MINING PRACTICE

The coal in this district lies near the surface but nowhere is the overburden stripped. The bed is reached by a slope at 17 mines; by a drift at 74; and by a shaft at 37. At a few mines where the coal is brought to the surface through vertical shafts, a slope is also provided for a manway and for exhaust of the ventilating current.

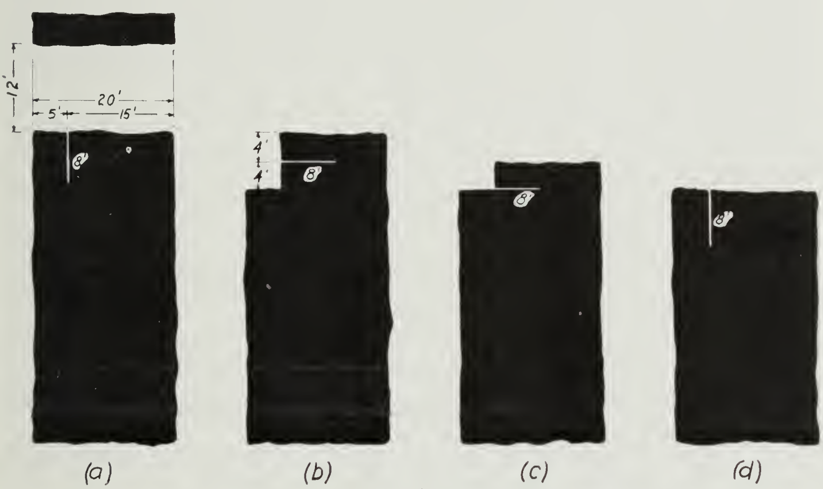

FIG. 2. Method of drawing pillars

The mining system at all but two of the mines is the simplest form of double-entry room-and-pillar. The coal is gained during the first working with a waste of pillar coal amounting to about 45 per cent of the bed. At the two exceptions a percentage of the bed large for Illinois room-and-pillar mines is extracted. At these mines 75 per cent of the pillar coal is recovered on the retreat.

A main-entry and parallel air-course, each 6 feet high and 8 feet wide, are driven from each side of the shaft toward the boundaries. From these main entries pairs of cross entries are driven every 500 feet at a right angle to the main entries. On the cross entries, after leaving a barrier pillar of 50 feet, rooms are turned on 45 foot centers. Room-necks are 7 feet long and

8 feet wide and are widened to the left at an angle of about 45 degrees reaching full room-width of 26 feet at a distance of 14 feet from the point where widening is begun. In the first room, number 1, on each entry the room-pillar cross cuts are closed by gob stoppings after the number 1 rooms have holed through; the line of number 1 rooms is kept open, thus providing two additional air courses inasmuch as cross entries are turned off both sides of the main haluage entry.

Fig. 3. Method of slabbing pillars

After the entry has been driven to the limit and the rooms on it worked out, beginning with the last pillar on the entry, room pillars are drawn until the pillar between rooms 3 and 4 is reached. The room pillars between the main entry and room 4 are left as a protection to the main entry and air course.

The method of drawing pillars is shown in fig. 2. When the room is driven up full length a 12-foot cut is made at the face of the room through the pillar (Fig. 2 "a"). A slab 5 feet wide (Fig. 2 "a") is then shot off the side of the pillar, after which a slab 4 feet wide is shot off the end (Fig. 2 "b"), and the pillar end is squared up again by shooting another slab 4 feet wide off the end (Fig. 2 "c"). The slabs shown in fig. 2, "b" and "c", are usually shot off with one 8-foot hole and a pop shot but occasionally a pop shot is unnecessary, as the first shot sometimes breaks off the entire slab. The process is repeated beginning again as in fig. 2 "d". Fig. 3 shows the coal as illustrated in the diagram fig. 2 "c". Fig. 4 shows the squared-up end of the pillar as illustrated in diagram fig. 2 "d".

The hard roof is easy of support and often stands before a break takes place while 25 to 200 feet of pillar is being drawn. When the roof weight becomes too heavy the roof breaks at the pillar ends. The cracking of the props gives ample warning of the break and work is discontinued until the roof comes down. The interval between the first heavy cracking of props and the roof break is usually not more than 12 hours.

Fig. 4. Squared-up end of pillar in slabbing

A break line of about 25 degrees with the face of the rooms is roughly maintained. It sometimes happens that roof falls prevent the men from getting into the squared-up pillar ends to continue drawing as described above, in which case a 12-foot cut is again made completely through the pillar as was done at the face of the room when drawing began and with this new pillar end the procedure continues as before. Very little pillar coal is lost from this cause. Mr. Carl Scholz, President, Coal Valley Mining Company, states that at their mine No. 3 at

TABLE 4.—*Dimensions of workings in feet.*

Mine no.	No. of bed	Depth of shaft	Past life in years	Entry width		Entry pillar width		Main barrier pillar width	Room		Room pillar width	Room-neck		Distance from entry to full room width	Width of cross-cuts	Squeezed?	Per cent of bed gained[a]
				Main	Cross	Main	Cross		Width	Length		Width	Length				
17	1	210	21	8	8	30	30	50	20	250	20	8	7	14	12	No	96
18	1	69	5	12	12	42	15	36	26	250 and 500	19	8	7	12	12	....	96
19	1	70	....	12	12	18	18	18	24	450	18	8	7	....	8	No	50
22	2	60	7	6	....	....	....	....	15	250	15	6	15	25	15	Yes	45
24	1	40	14	12	12	20	20	15	24	300	21	8	7	29	15	No	70

[a]Estimates furnished by operators.

Matherville the loss of pillar coal does not exceed four per cent.

The cost of producing coal is much less on pillars than on advance work in rooms. Room coal costs an average of $1.25 per ton at the pit mouth at the No. 3 mine of the Coal Valley Mining Company and pillar coal, $1.015. This difference in cost exists because track, yardage, bottom digging, and driving through rolls and slips are very properly charges against room coal while there are no such charges against pillar coal. When pillars are drawn, therefore, the average cost per ton for the total production is materially reduced. At this mine rooms are worked with one man at the face but two men are placed at each pillar and at the face of each entry.

With the extraction of such a large percentage of the bed surface subsidence should be expected. The topography of the surface is rolling and subsidence is usually indicated by cracks in hillsides. The largest single area affected was reported to be one acre which, it is stated, subsided from 6 to 12 inches.

Table 4 gives dimensions of workings at the mines examined in the district.

No large flows of water are found in any mines and small steam pumps near the shaft bottom suffice to keep the mines dry.

The laborers in the district are chiefly Americans, English and Scotch. There are some Swedes and Slavs. Physical conditions in the mines are such that any miner can earn excellent wages. Face workers in shipping mines in District III gain daily on the average one and one-third tons more coal than do face workers in the rest of the State, the ratio being 7.6 to 6.3 as shown in Table 5. The district contains only mines of small production and consequently there are disproportionately few underground employees to each surface employee. Therefore the daily production per employee is somewhat lower than in all other districts combined. At one mine the number of "company men" employed underground and on the surface equals the total number of face workers.

The production of the district is so small and the number of employees so few that accident statistics are of little value. During the year ended June 30, 1912, there were four fatal accidents making the number of deaths per 1000 employees 3.6 as compared with 2.3 for the State as a whole. There were 128,045 tons of coal produced to each life lost as compared with 319,524 tons for the State.

TABLE 5.—*Per capita production of coal*

Mine no.	Employees				Average daily tonnage	Underground employees for each surface employee	Tons per day per surface employee	Tons per day per underground employee	Tons per day per face worker (miners, loaders, machine men)	Tons per day per employee
	Surface	Underground	Face workers (miners, loaders, machine men)	Total						
17	23	126	83	149	500	5.5	21.7	4.0	6.0	3.4
18	25	165	120	190	850	6.6	34.0	5.2	7.1	4.5
19	13	192	125	205	850	14.8	65.4	4.4	6.8	4.1
22	1	10	8	11	30	10.0	30.0	3.0	3.8	2.7
24	8	80	56	88	350	10.0	43.8	4.4	6.2	4.0
District[a]	142	977	406[b]	1,119	3,794	6.9	26.7	3.9	7.6	3.4
All other districts combined[a]	6,907	71,385	52,912[b]	78,292	355,670	10.3	51.5	5.0	6.3[b]	4.5

[a]For the year ended June 30, 1912.
[b]Shipping mines only.

VENTILATION

The thin cover overlying the coal makes good ventilation of mines in the district easy to obtain because the sinking of shallow shafts or slopes is comparatively inexpensive. Several mines are provided with a slope or shaft for ventilation in addition to the usual air-shaft prescribed by law, thus making overcasts unnecessary. Hence, ventilation presents no difficult problems and on account of comparative freedom from gas the quantities of air delivered by the fans are small, 52,000 cubic feet per minute being the largest volume recorded. Fans are usually not reversible but are designed for blowing permanently.

TABLE 6.—*Pressure developed by dust of face samples in explosibility apparatus*

District	No. samples	Pressure in pounds per square inch at 2192 degrees F.
I	11	8.400
II	5	5.880
III	5	7.805
IV	17	7.700
V	7	7.105
VI	16	5.950
VII	24	7.175
VIII	6	8.925

The dust on the ribs is comparatively wet in most mines and no serious explosions have occurred. Face samples of the coal when dried and reduced to 200-mesh size are very explosible as shown in Table 6 which compares average explosibilities of the coals of each district. The pure coal dust of bed 2 in this district develops in the explosibility apparatus a pressure of 7.00 pounds per square inch at a temperature of 2192 degrees F. The dust of bed 1 develops a pressure of 8.00 pounds. The average pressure developed by all samples collected in District III from mines in beds 1 and 2 is 7.81 pounds per square inch. Freedom from explosions is obtained by the moisture of the dust and by the admixture of shale dust with the coal dust on the ribs of entries. The shale droppings from the roof are ground up by the car wheels and the feet of men and mules and the fine dust thus made is thrown into suspension in the air by the passage of trips and settles on the ribs. The swelling of the floor in several mines provides a further supply of inert dust as the floor material soon becomes ground into fine dust.

FIG. 5. Typical gob stopping

The humidity of mine air in the district is normal. At one mine two hygrometers were installed; one in the intake and one in the return. Readings of these hygrometers were taken three times daily during a period of one year. These readings gave for the year an average relative humidity of 91.29 per cent for intake air and 95.10 per cent for the return air. The average temperature of the return air for the year was 68.07 degrees F.

TABLE 7.—*Data relative to ventilation*

Mine no.	Depth of air-shaft in feet	Size of shaft in clear in in feet	Type of fan	Diameter of fan in feet	Width of fan in feet
17	210	6 by 12[a]	Paddle	18	4
18	69	8 by 10[b]	Robinson	10	4
19	70	8 by 12	Paddle	12	3½
22	60	4 by 5	Paddle	6	2½
24	40	6 by 8	Paddle	6	4

[a]Also has third shaft, 8 by 14 feet for escapement.
[b]Mine also has slope for escapeway and auxiliary air-return.

The presence of pyrites in the floor causes gob fires where any fine coal is left in the gob. Such fires are numerous and cost from $5 to $150 to extinguish. Where possible they are loaded out on mine cars. Where they can not be loaded out they are shut off with gob seals.

Gob stoppings are general. Fig. 5 shows a typical stopping for the district. Those stoppings appeared to be comparatively efficient in one or two mines but generally are leaky. A gob stopping in place 4 feet thick costs 8 cents per square foot of face. The total ventilation cost at one efficiently managed mine is 3.9 cents per ton of coal hoisted. In determining ventilation cost at this mine wages of foreman, assistant foreman, pumpers, trappers and water bailers are apportioned in the segregation of items and vetilation is charged with its proportionate amount.

Table 7 gives data on ventilation.

BLASTING

One mine uses coal cutting machines but the output of undercut coal is only 1.9 per cent of the total production of the district. The average production per keg of powder is 20.2 tons. Black powder is used exclusively and is purchased in steel kegs. Sizes F, FF, and FFF are used at the mines examined. Shots are fired by fuse in every mine.

The blasting methods in the small mines which use powder are wasteful of explosive and produce an unnecessary proportion of slack. Holes 12 feet deep are not uncommon. At the mines which use powder the diameter of holes is 2½ inches.

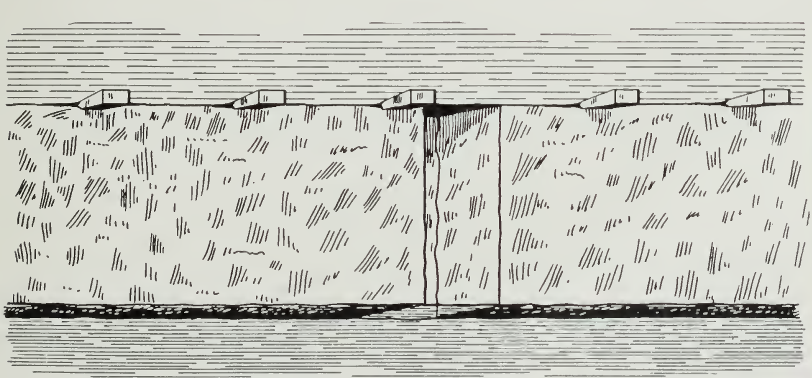

FIG. 6. Method of gaining coal without using powder

In several shallow country banks with irregular outputs not exceeding 50 tons per day no shooting is done in gaining the coal. The coal is brought down by wedge and sledge as shown in fig. 6. Vertical cuts about 18 inches wide and two feet deep are made in the coal at 15 foot intervals and an undercut about three inches high and two feet deep is made along the face. Steel wedges are driven between roof and coal at three-foot intervals and the coal breaks away in large blocks. The longwall system can not be used at these mines because where the coal is removed under any considerable area of roof, caves extend to the surface and sand and water pour into the mine. For the same reason no attempt to draw pillars is made.

At the No. 2 mine of the Coal Valley Mining Company at Sherrard shooting in rooms is done off the solid but one-half of the face is kept about eight feet in advance of the other half. The small amount of powder required per ton of coal to gain the rear half of the face is offset by the amount it is necessary to use to bring down the tight coal of the advanced half.

TABLE 8.—*Blasting data*

Mine no.	Undercutting or shooting off solid	Size of powder	Pounds of powder per ton of coal	Tons of coal per keg of powder	Powder cost in cents per ton of coal	Length of holes in feet	Holes per shot-firer	Per cent of coal over 1¼ inches[b]
17	Solid shooting	F. & F. F.	1.39	18	9.73	3 to 12	61	75
18	Solid shooting	F. F.	1.39	18	9.73	4 to 9	100	75
19	Solid shooting	F. & F. F.	1.56	16	10.92	4 to 12	125	----
22	No shooting[a]	-------	-------	----	-------	-----------	----	80
24	Solid shooting	F. F.	1.39	18	9.73	4 to 10	38	70

[a]Use sledge and wedge.
[b]Figures supplied by operators.

At the smaller mines where powder is used it is carelessly handled and often delivered to the working places during the day while the men are in the mine. The large charges often used are responsible for frequent blow-out and windy shots which amount to one per cent of all shots at some mines. About two per cent of shots misfire.

Table 8 gives blasting data for the mines examined.

TIMBERING

Timbering in this district is devoid of interesting features. The roof is very strong and stands without support in moderate spans.

In nearly all small mines occasional entry sets at clay veins are the only timbers used except at the mine entrance.

Split room-props are usually bought. A high percentage of white-oak props is obtainable in this district; shipments containing from 25 to 50 per cent of white oak. The length purchased varies from 3½ to 4½ feet. The life of props averages 18 months on the return air ways.

It is not unusual to find rooms where no propping at all has been done and even in the larger mines propping is not systematic. The roof is often unsupported for a distance of 50 to 75 feet from the face. A more frequent inspection of the working places would result in a decrease of accidents from fall of roof and coal.

In pillar drawing props are set 10 to 15 feet from the face and are spaced at irregular intervals. Spragging the coal should be enforced during pillar-drawing where the coal is undercut by hand.

At all of the mines examined shafts and slopes are timber lined. No steel is used for roof support. The shaft bottoms are usually lined with 12 to 18-inch framed 3-piece sets carrying 2-inch lagging. The legs of the sets are usually given a batter of one inch for each vertical foot between collar and rail.

At one mine with a daily production of 850 tons the total timbering cost including labor in timbering entries is 1.1 cents per ton of coal hoisted. An average cost of 2.5 cents per ton is estimated for the district.

HAULAGE

In the thin seams of District III entries are not sufficiently high for animal haulage after the coal has been removed. The necessary height is provided at each mine examined by lifting about one foot of the fireclay floor.

The outputs of the largest mines in the district are so small that haulage at high speed either on the main entries or in gathering is unnecessary. Mechanical haulage is used in only four of the 128 mines in the district and mule haulage in 7. In the other 117 mines cars are pushed by hand. Where the coal is pushed by hand small cars are used weighing empty from 225 to 250 pounds and holding about one-half ton of coal. In one mine, cars for many years were hauled to the bottom by dogs as shown in fig. 7. At two of the mines examined coal is moved from the partings to the bottom by main-and-tail rope. At one of these the haul is 1¾ miles; at the other, 2000 feet. Second-motion engines located near the bottom of the shaft operate winding drums three feet in diameter. The inby bullwheel is 4 feet in diameter at each mine and both main and

Fig. 7. Pit-car hauled by dog (Photo by Mr. James Taylor)

tail ropes are ¾-inch diameter. At one of these two mines, which has an output of 850 tons daily, there are 250 cars underground. Each car weighs empty 1600 pounds and has a capacity of 1½ tons when topped 14 inches. Twenty loads are hauled out in each trip. At the other mine, which produces 500 tons daily, there are 350 cars underground but each car weighs empty only 800 pounds and has a capacity of one ton with 14 inches of topping. Trips average 56 cars. Haulage costs at these two mines approximate 7 cents per ton of coal

TABLE 9.—*Data relative to underground haulage*

Mine no.	Kind of haulage		Locomotive weight in tons and number of each weight	Miles traveled per shift by locomotives	Ton mileage of locomotives	Track gage in inches	Rail weight in pounds per yard		Weight of pit cars in pounds	Capacity of cars in pounds	Ratio of coal to car-weight	Percentage of total weight which is car-weight
	Main	Secondary					Main haulage	Secondary haulage				
17	Main and tail-rope	Mules	....	....	....	29½	60	20 and 12	800	2000	2.50	28.6
18	Main and tail-rope	Mules	[a]	....	....	36	20	16 and 12	1600	3000	1.88	34.8
19	Gasoline locomotive	Mules	One 5[b]	28.41	512	36	30	16	1500	3000	2.00	33.3
22	Hand	Hand	....	....	....	26	10	10	220	1000	4.54	18.0
24	Gasoline locomotive	Ponies and mules	One 7[b]	11.36	150	36	25	12	1200	2000	1.67	37.5

[a]Four-ton gasoline locomotives are being tried for gathering.
[b]Figures refer to weight of locomotive.

hoisted. This amount does not include cost of steam for winding engine but does include cost of gathering with mules. Gathering alone costs 4½ cents per ton. The company operating these mines raises all mule feed on its own land and the feed and care of mules average $5 per month per mule. The company pays $135 each for mules whose working life averages eight years. At the mine with 500 tons output there are 14 mules for gathering. Each mule in gathering hauls two loaded cars to the partings. The average haul is 1800 feet and each mule pulls an average of 38 loaded trips per day. The average grade in favor of the loads is 2 per cent. The road bed at these mines is in excellent condition.

Gasoline locomotives are used at two mines. Their ton-mileage is low because the output of the mines is small and the locomotives are never worked to capacity. Haulage costs were not available at either mine. At one of them with a production of 850 tons the ton mileage of the locomotive is 512. At this mine the haul for loads from partings averages 1500 feet. This locomotive which weighs 5 tons uses 8 gallons of gasoline per shift; one gallon for each 106 tons of coal hauled.

At the other mine there is a 7-ton gasoline locomotive. Here the output is 350 tons daily. This locomotive uses 12 gallons of gasoline per shift; one gallon for each 29.2 tons hauled. It requires 2½ gallons of engine oil daily; one gallon for each 140 tons hauled. This locomotive has a ton mileage of only 150. Its poor performance and high consumption of gasoline and lubricant are due to light rails and neglect of the road bed which is in poor condition having high grades and many sharp curves.

In this district it is the universal custom to stable mules and ponies, which are used at some mines, on the surface. The cost of a pony is about $150.

Table 9 gives haulage data for the mines examined.

HOISTING

The mines of this district are shallow and their production is small. Coal is brought to the surface by steam hoists at 42 mines; it is brought out in drifts by horses or hoisted through shafts by horse whims at 21; and by hand is hoisted by windlass or pushed to the drift mouth at 65. There has been no necessity for the development of speed in hoisting and even at the largest mines the hoisting engines are small. At every mine examined a second motion engine is used. The Coal Valley Mining Company uses skips instead of cages for hoisting coal. For hoisting men and lowering timbers and other supplies, cages are used. The hoisting shafts at these mines have four compartments; two for skips and two for cages. The coal is dumped, as shown in fig. 8, into a hopper built beneath the floor of the shaft bot-

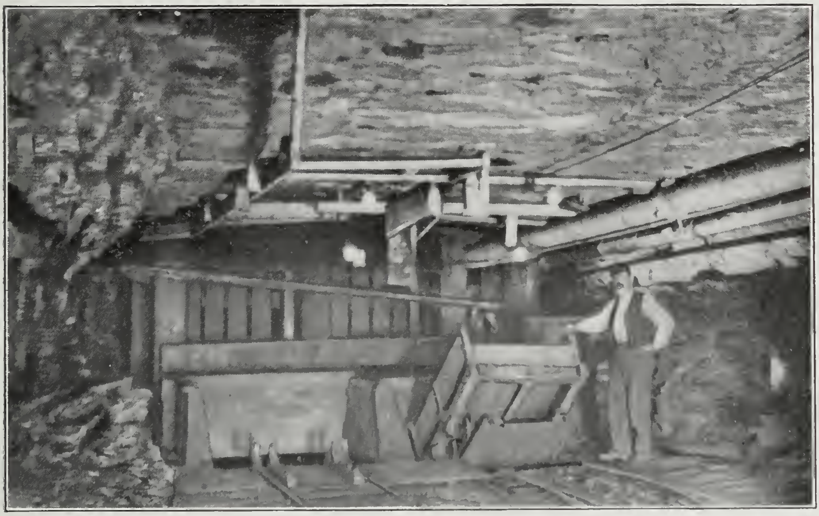

FIG. 8. Hopper for receiving coal at bottom of shaft

tom. Each of the two compartments of the hopper has a capacity of two pit cars. The hopper discharges automatically into the skips.

TABLE 10.—*Hoisting data*

Mine no.	Average daily tonnage	Self dumping cage?	Hoisting shaft		Hoisting engine cylinder (Size in inches)	Boilers		
			Depth in feet	Size in feet		No.	Total H.P.	Average steam pressure (pounds per square inch)
17	500	Skip	210	14 by 14½	14 by 24	7	500	100
18	850	Skip	69	10 by 14	14 by 24	3	750	110
19	850	No	70	8 by 16	13 by 16	3	450	100
22	30	No	60	6 by 12	....	1	16	70
24	350	No	40	7 by 14	9 by 12	2	300	90

At no mine examined is caging performed automatically.

Signalling from the shaft bottom to the engine room at the smaller mines is done by pulling a wire which rings a bell in the engine room. The pneumatic signalling device is not in general use. The hoisting cable is either $1\frac{1}{8}$ or $1\frac{1}{4}$ inches in diameter.

Table 10 gives hoisting data.

PREPARATION OF COAL

At nearly all the small mines the coal is sized over a short gravity bar-screen and only two sizes are made: lump, over $1\frac{1}{4}$ inches and screenings, under $1\frac{1}{4}$ inches. The per cent of coal over $1\frac{1}{4}$ inches in size produced in the district is estimated at 70. Several mines have shaking screens; usually with two decks. One mine is equipped to make seven sizes. Theses sizes are rarely all made in one run and usually only three are made at any one time. The seven sizes are:

Name	Size
Lump	Over 6 inches
Egg	Through 6 inches; over 3 inches or Through 6 inches; over 2 inches or Through 6 inches; over $1\frac{1}{4}$ inches.
No. 1 nut	Through 3 inches; over $1\frac{1}{4}$ inches.
No. 2 nut	Through 2 inches; over $1\frac{1}{4}$ inches.
Pea	Through $1\frac{1}{4}$ inches, over $\frac{3}{4}$-inch.
Slack	Through $\frac{3}{4}$-inch.

TABLE 11.—*Preparation of coal for market*

Mine no.	Sizing screen				Per cent of total output over $1\frac{1}{4}$ inches
	Type	Length in feet	Width in feet	Shakes per minute	
17	Shaking	18	12	80	75
18	Shaking	12	7	85	75
19	Shaking	34	6	90	....
22	Gravity	12	6	....	80
24	Shaking	32	$5\frac{1}{2}$	90	70

Inasmuch as the market for much of the coal produced is local, sizes are made to meet local demand. At one mine 6-inch lump is made and also 2-inch lump. There is a local demand at this mine for 6-inch mine run. The demand is met by putting the undersize from the 2-inch lump into the 6-inch lump.

Table 11 gives data on preparation of coal for market.

There are no steel tipples in the district. Fig. 9 shows the surface plant at an average local mine.

The power plants at the mines of the Coal Valley Mining Company are remarkable for efficiency. Coal is automatically

Fig. 9. Surface plant at local mine (Photo by F. H. Kay)

stoked under the boilers and ashes are automatically removed. At these mines 1.7 per cent of the total production is burned at the plant.

There are in the district no installations of air compressors or electric generators to furnish power for undercutting machines.

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Bulletin 2. Coal Mining Practice in District VIII (Danville), by S. O. Andros, 1914.

Bulletin 3. A Chemical Study of Illinois Coals, by Prof. S. W. Parr, 1914.

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Bulletin 83, United States Bureau of Mines, The Humidity of Mine Air, by R. Y. Williams, 1914. (Copies of this bulletin can be obtained by addressing the Director, Bureau of Mines, Washington, D. C.)